6.0 AFFECTED ENVIRONMENT

6.1 Introduction

This chapter describes the area of the environment to be affected by the alternatives proposed for Cartersville Dam. Impacts to the environment are described in the next chapter.

Issues or resources are organized in the following categories:

- Ecological Resources
- Cultural Resources
- Aesthetic Resources
- Water Quality and Related Requirements
- Air Quality

6.2 Ecological Resources

6.2.1 Introduction

This section emphasizes ecological resources and ecosystems restoration, with particular consideration of fish and wildlife resources. Ecological resources include a natural form, process system or other phenomenon that is related to land, water, atmosphere, plants, or animals which has attributes or properties which sustain and enrich human life (USACE, 2000). Categories include:

- Hydrology
- Geomorphology
- Federally-Listed Species and State Species of Special Concern
- Lands and Vegetation
- Aquatic Assemblages
- Recreation
- Wetlands

6.2.2 Hydrology

6.2.2.1 Introduction

This section describes the existing hydrologic conditions for the Yellowstone River at Forsyth, Montana.

6.2.2.2 Method

Data from U.S. Geological Survey (USGS) gage 06295000, Yellowstone River at Forsyth, located approximately one mile upstream was used in this study. The period of record for this gage is July 16, 1921 to September 30, 1923 (no winter records) and October 1977 to the current year.

6.2.2.3 Existing Conditions

Annual mean discharge for the gage is 10,600 cubic feet per second (cfs). Daily mean discharge which was equaled or exceeded for 99 percent of time and 1 percent of time based on 25 years of record was 2560 cfs and 48,800 cfs, respectively. The one-day 20-year recurrence low flow is 1640 cfs. The one-day 50-year recurrence high flow is 99,000 cfs. The maximum peak flow was 106,000 cfs on May 21, 1978. The lowest daily mean was 1400 cfs on November 23, 1977.

6.2.3 Geomorphology

This section describes the geomorphologic characteristics of the Yellowstone River that may be affected by the Cartersville Dam fish passage project. The geomorphic characteristics of the area that may be affected include channel characteristics (morphology) and channel modifications such as extents of bank armor.

6.2.3.1 Method

Available literature and existing GIS data were reviewed as part of the assessment of the geomorphology of the Yellowstone River in the project area. Historic aerial photographs from 1950, 1976, 1995, 2001, and 2007 were utilized to identify historic changes in planform in the area, and to measure bank erosion rates and mid-channel bar area at the site.

6.2.3.2 Existing Conditions

A mid-1970's report by Koch (1977) characterizes the Yellowstone River as having a branching and braided reaches with wooded islands and gravel bars, separated by reaches with very few islands and minimal bars. River valley and valley wall configurations largely control the form of the river; in general, the river follows the valley walls until the orientation of the river valley axis changes. At that point, the channel commonly crosses the valley bottom to the opposite valley wall. In areas where the river is not directly against a valley wall, the channel is more dynamic, and assumes a braided or a branching (multi-channeled) planform (Koch, 1977).

In the vicinity of Forsyth, the Yellowstone River follows a meandering planform that is partially confined by a bedrock valley wall to the north (AGI and DTM, 2004). This valley wall is comprised of Late Cretaceous-age (66 to 71 million year old) Lance Formation, which consists of sandstones and shales that are up to 300 feet thick near Forsyth (Vuke et al, 2001). Upstream of the diversion dam, on the south bank of the river, a floodplain dike separates the city of Forsyth from the active river corridor. The armored and levied bankline at Forsyth coupled with the bedrock bluff on the opposite bank has confined the Yellowstone River into a narrow corridor that has shown little change in the last 50 years (Figure 6-1 and Figure 6-2).

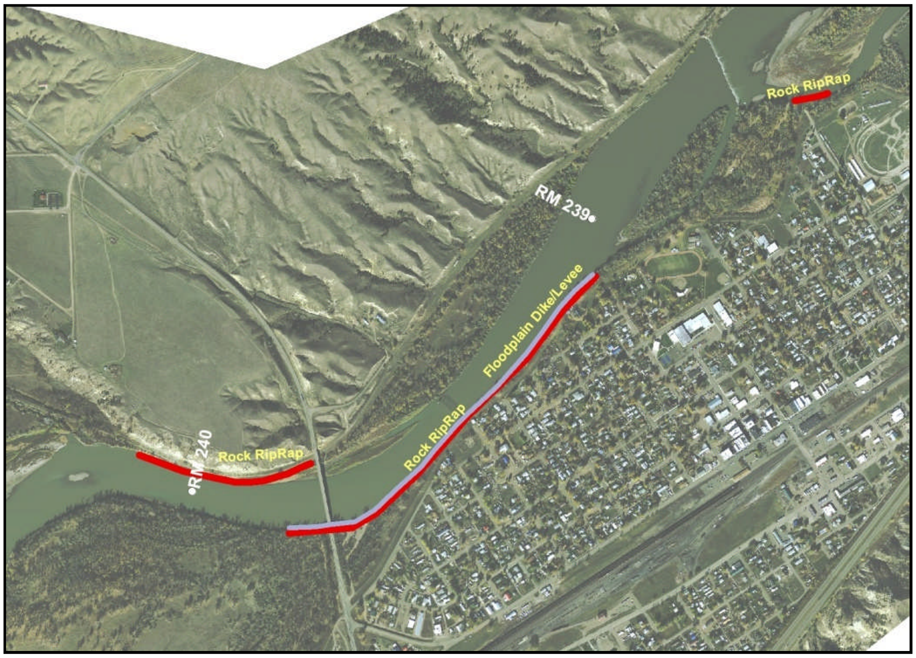


Figure 6-1 Aerial Photograph of Yellowstone River Above Cartersville Dam Shows Mapped Extents of Riprap (red) and Floodplain Dike/Levee (lavender)

6.2.3.3 Sediment Sourcing From Upstream Cutoffs

Several miles upstream of Cartersville Dam, the Yellowstone River flows through the Hammond Valley. In this section of river, the river is largely unconfined, flowing through a series of broad meander bends. Two bendways have cut off in the Hammond Valley in the past 50 years; one between 1950 and 1976, and another during the 1996/1997 flood events (Figure 6-3 and Figure 6-4). These bendway cutoffs have been characterized by the excavation of a new channel across the neck of the bend, and abandonment of the old bend as an oxbow channel remnant. Such events create accelerated sediment loading downstream (Whitaker et al, 2008). For example, the cutoff at River Mile 243.8 (Figure 6-3 and Figure 6-4) occurred during the floods of 1996 and 1997. Approximately 28 acres of land were eroded out as the new channel formed. If an excavation depth of 6 feet over the eroded area is assumed, the event produced on the order of 268,000 cubic yards of material.

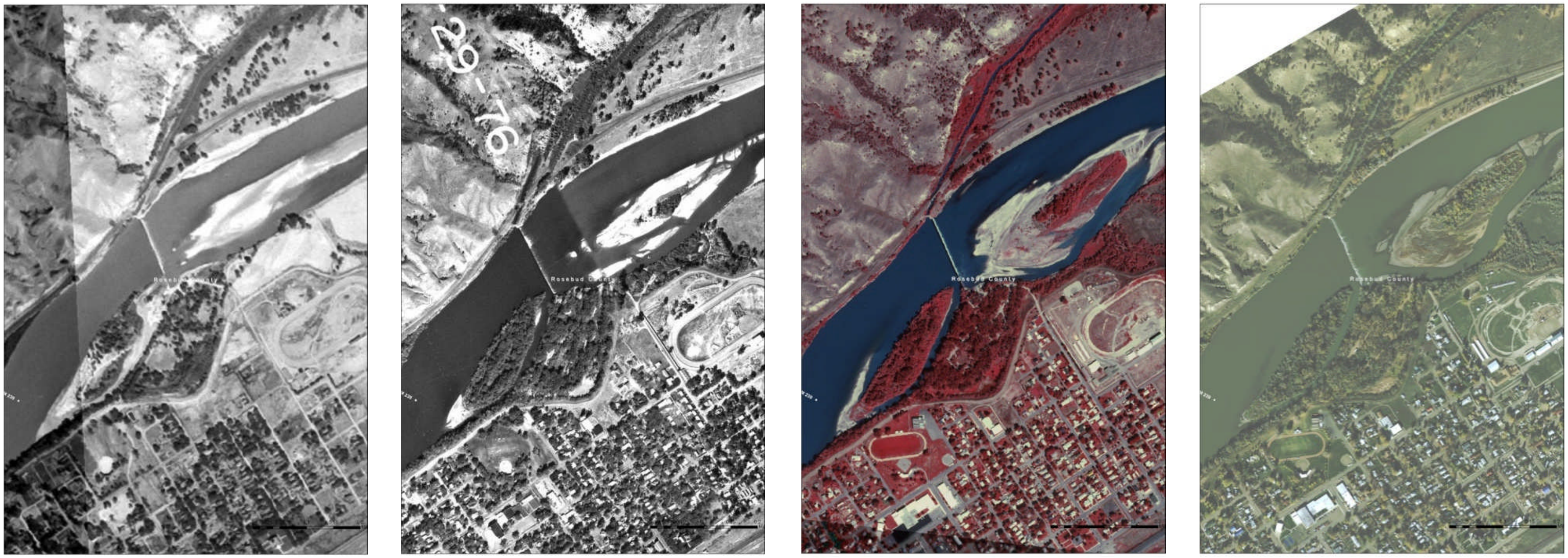


Figure 6-2 **Yellowstone River at Cartersville Dam Showing (left to right), 1950, 1976, 2001, and 2007 Conditions**

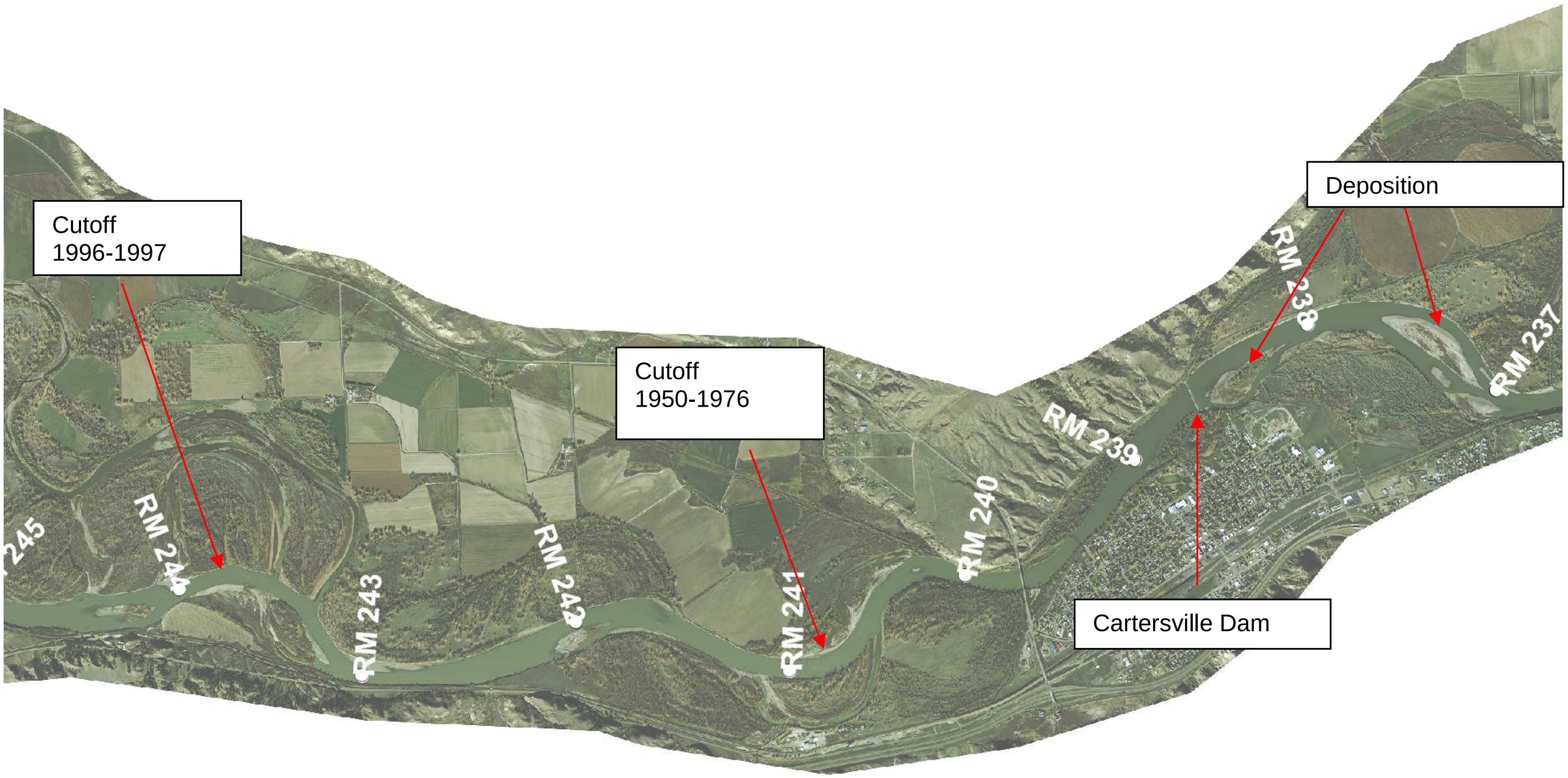


Figure 6-3 Yellowstone River at Cartersville Dam, 2007 Showing Areas of Bendway Cutoff and Downstream Deposition

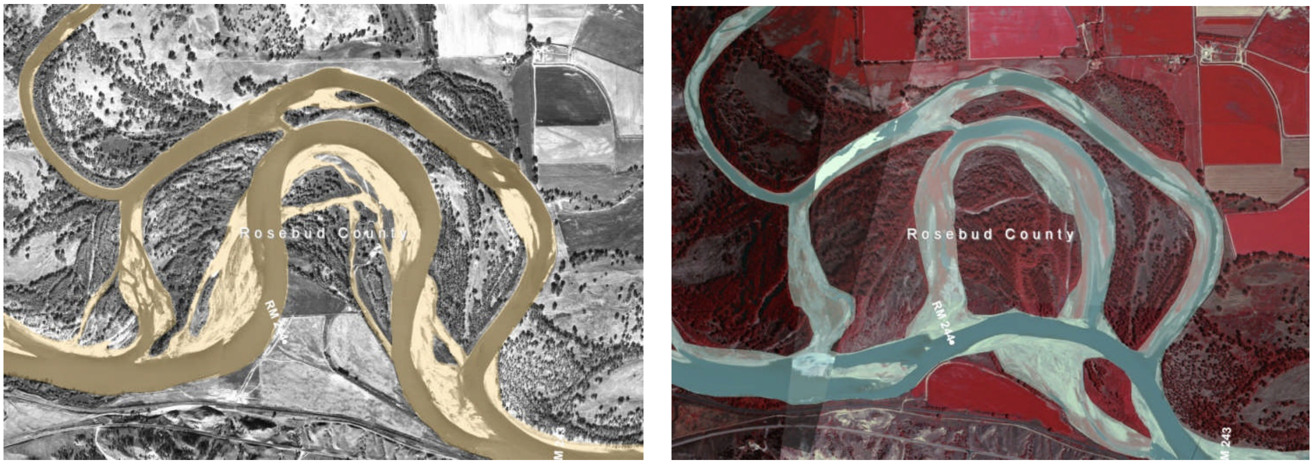


Figure 6-4 Hammond Valley Bendway Cutoff Between 1976 (left) and 2001 (right)

Bendway cutoffs create a sediment pulse that typically results in deposition downstream (Schumm, 1977). Just upstream of Cartersville Dam, the Yellowstone River is confined between the bluff line and Forsyth dike, and there is no evidence of recent deposition in this reach. Downstream of Cartersville Dam, however, the channel flows away from the valley wall and hence is less confined and prone to more active planform change. Two areas, located at RM 237.5 and RM 238.5, are within one mile of the dam and have shown substantial bank migration and mid-channel bar growth since 1950 (Figure 6-5). The downstream site, at RM 237.5, consists of a large bendway that is actively migrating to the northeast. The bendway has migrated approximately 470 feet between 1950 and 2007, reflecting an 8.2 feet per year average migration rate. The second site is located immediately downstream of the dam, where mid-channel bar growth has been accompanied by right (south) bank erosion (Figure 6-6). Since 1950, the bank has migrated approximately 270 feet at the site, reflecting an average migration rate of 4.7 feet per year. This site is currently protected by discontinuous bank armor.

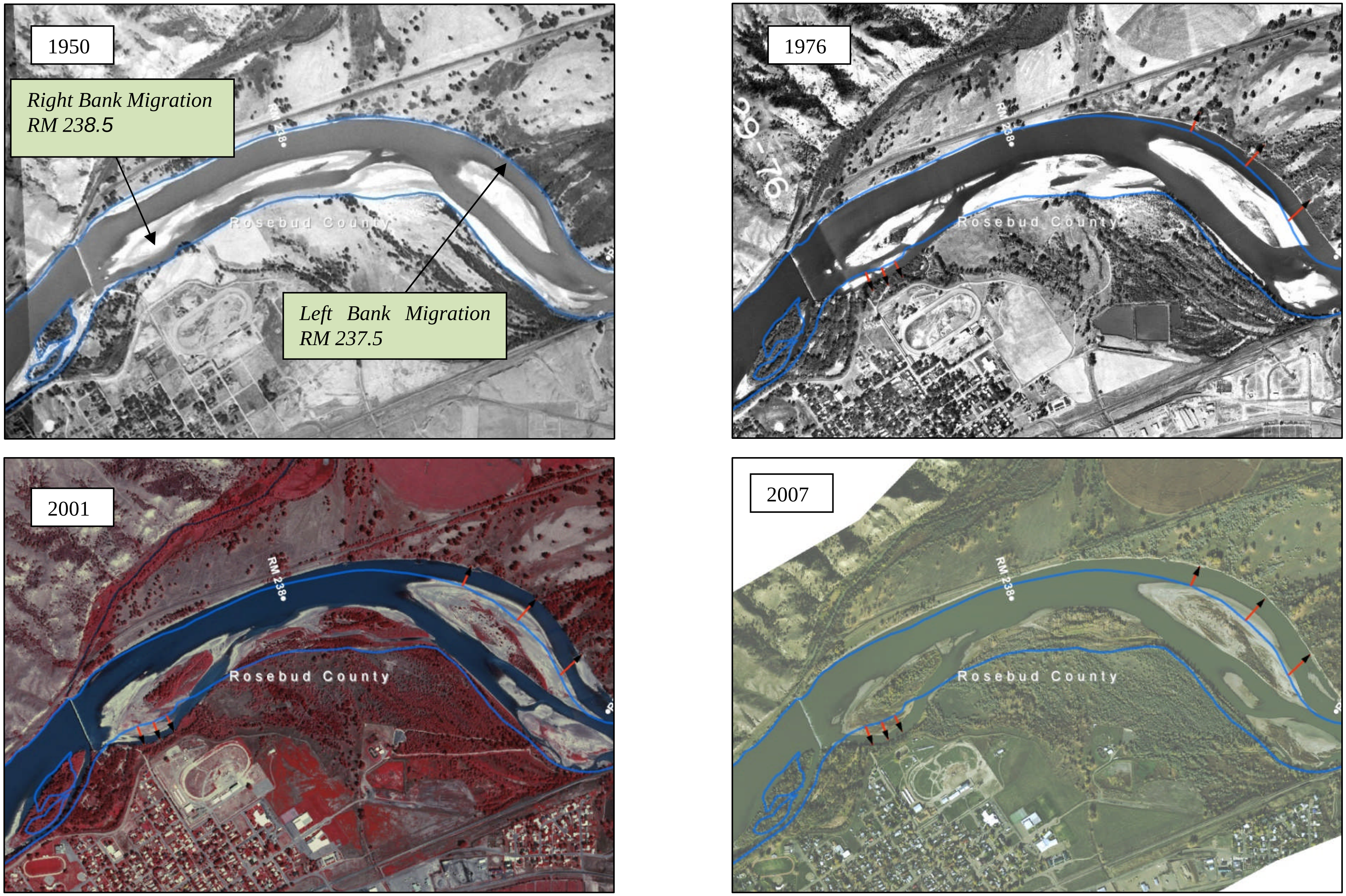


Figure 6-5 1950-2001 Bank Erosion (red arrows), Showing Island Growth and Bank Retreat Downstream of Cartersville Dam. Blue Lines are 1950 Bankfull Boundaries

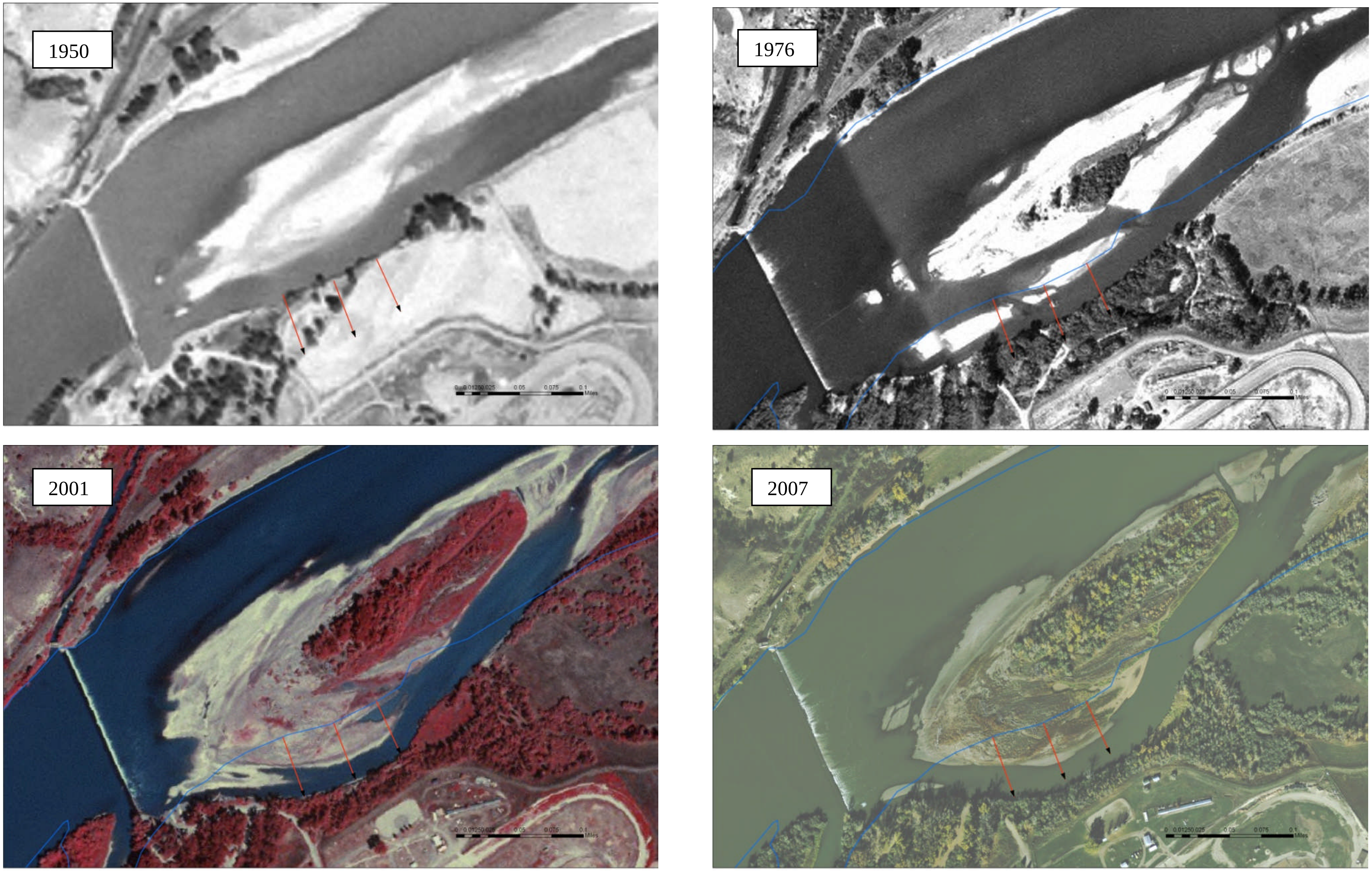


Figure 6-6 Close Up View of 1950-2001 Bank Erosion (red arrows) Immediately Downstream of Cartersville Dam. Blue Lines are 1950 Bankfull Boundaries

An assessment of channel migration rates through time indicates that at both sites, the highest rates of channel movement occurred between 1995 and 2001 (Figure 6-7). During this time frame, the right bank site immediately downstream of the dam migrated at an average rate of approximately 8 feet per year, and the downstream site moved at an average rate of 10 feet per year. The time frame between 1950 and 1976 was characterized by the average migration rates of over 6 feet per year at both sites. Channel migration was less active from 1976 to 1995 and from 2001 to 2007.

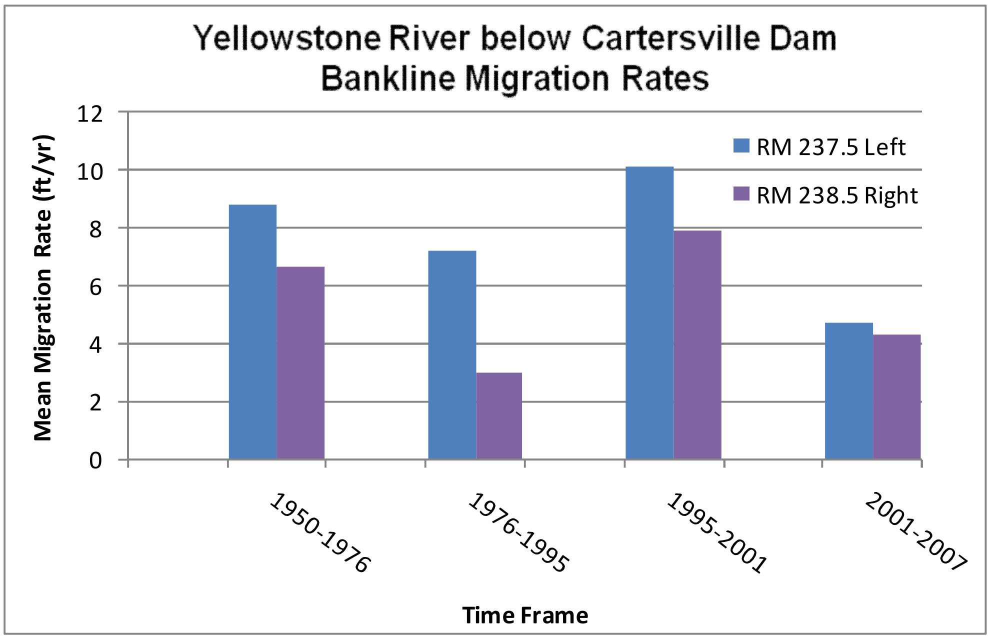


Figure 6-7 Measured Bankline Migration Rates Immediately Downstream of Cartersville Dam

Right Bank at RM 238.5, and Approximately One Mile Downstream on the Left Bank at RM 237.5

A measurement of the aerial extent of the bar features through time indicates that the bars have grown since 1950, but that the growth rates have tapered off since 2001 (Figure 6-8). As the flows varied during the timeframes in which the air photos were taken, the measured expansion of mid-channel bars could reflect differences in river stage. Table 6-1 lists the approximate discharges present at the time of the aerial flight. The lowest flow conditions captured in the photography are during the 1950 and 2001 flights, when flows were approximately 3500 cfs. Although the flows were similar, the downstream bar was over two times larger during the more recent flight. This is similar for the 1995 and 2007 measurements; although the flows were similar, the later timeframe is characterized by a larger bar extent. The results of the bankline migration and bar development assessment indicate that downstream of Cartersville Dam, bank migration that has occurred over the last 50 years has been accompanied by mid-channel bar growth.

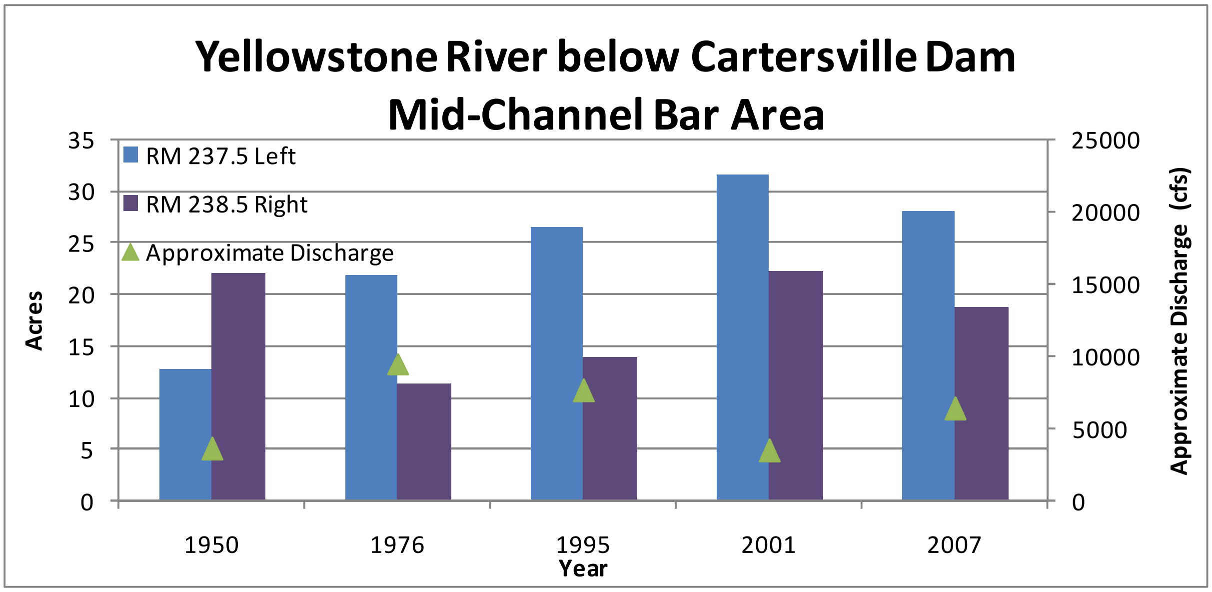


Figure 6-8 **Exposed Area of Mid-Channel Bars Downstream of Cartersville Dam**

Table 6-1
Measured Extent of Two Primary Mid-Channel Bars Downstream of Cartersville Dam Through Time

Date	Approximate Discharge (cfs)	Bar Size RM 237.5 (acres)	Bar Size RM 238.5 (acres)
1950	3620	12.8	22.0
1976	9520	21.8	11.4
1995	7650	14.0	26.6
2001	3500	31.6	22.3
2007	6400	28.1	18.7

There is no clear evidence of deposition and bar growth upstream of Cartersville Dam, where the river is confined between bedrock bluffs and a floodplain dike. However, bar growth and bank erosion have been measured downstream of the dam structure where the river is less confined. The proximity of the Hammond Valley upstream, coupled with the evidence of sediment production from cutoff events, suggests that periodically, accelerated sediment loading has occurred through the reach, which may have resulted in bar growth downstream of Cartersville Dam. It is unclear whether these bars will continue to grow in the future; a measurement of bar area indicates that at both sites, bar growth has tapered off. However, the results indicate that the geomorphology of the Yellowstone River downstream of Cartersville Dam is in part a reflection of periodic influxes of sediment from bendway cutoff events in the Hammond Valley. These natural processes of bendway formation, cutoff, and sediment transport downstream are likely to continue in the future, indicating that periods of accelerated sediment delivery, bar formation, and bank erosion will be characteristic of the site.

6.2.4 Federally-Listed Species and State Species of Special Concern

6.2.4.1 Introduction

This section describes the federal and state conservation status of plant and animal species in the vicinity of the Cartersville Dam site. These species have the potential to be affected by proposed improvements to the Cartersville Dam.

6.2.4.2 Method

All information about species of special concern in the vicinity of Cartersville Dam were obtained from the Montana Natural Heritage Program website (http://mtnhp.org/). This information is summarized in Table 6-2. Because few studies have been conducted in the Forsyth area, information is provided for each species from a variety of geographic area..

6.2.4.3 Existing Conditions

6.2.4.3.1 Golden Eagle

6.2.4.3.1.1 Habitat

Golden eagles nest on cliffs and in large trees (occasionally on power poles), and hunt over prairie and open woodlands. Cliff nesting sites are selected for southern or eastern aspect, less than 200 inches of snowfall, low elevation, and availability of sagebrush/grassland hunting areas. Golden Eagle — *Aquila chrysaetos.* Montana Field Guide. Retrieved on January 21, 2010, from http://FieldGuide.mt.gov/detail_ABNKC22010.aspx

6.2.4.3.1.2 Food Habits

In Montana, golden eagles eat primarily jackrabbits, ground squirrels, and carrion (dead animals). They occasionally prey on deer and antelope (mostly fawns), waterfowl, grouse, weasels, skunks, and other animals. Golden eagles rarely prey on livestock, but when they do, losses usually occur in areas where migrating eagles congregate. Golden eagles can carry no more than about seven pounds while flying.

6.2.4.3.1.3 Ecology

Nesting density varies year to year from 55 to 105 sq.mi./pair. Eagles move to higher elevations after leaving nest.

Table 6-2
Species of Special Concern in the Vicinity of Cartersville Dam (Montana Natural Heritage Program)

Species of Concern

Common Name			Scientific Name						
Class	Family	Species	Class	Family	Species	Global Rank	State Rank	ESA Rank	Habitat
Birds	Hawks / Eagles	Golden Eagle	Aves	Accipitridae	Aquila chrysaetos	G5	S3		Grasslands
Birds	Herons	Great Blue Heron	Aves	Ardeidae	Ardea herodias	G5	S3		Riparian forest
Birds	Upland Game Birds	Greater Sage-Grouse	Aves	Phasianidae	Centrocercus uropha	G4	S2		Sagebrush
Birds	Hawks / Eagles	Bald Eagle	Aves	Accipitridae	Haliaeetus leucocep	G5	S3	DM	Riparian forest
Reptiles	Softshell Turtles	Spiny Softshell	Reptilia	Trionychidae	Apalone spinifera	G5	S3		Prairie rivers and larger streams
Reptiles	Sagebush / Spiny Lizards	Greater Short-horned Lizard	Reptilia	Phrynosomatidae	Phrynosoma hernan	G5	S3		Sandy / gravelly soils
Fish	Suckers	Blue Sucker	Actinopterygii	Catostomidae	Cycleptus elongatus	G3G4	S2S3		Large prairie rivers
Fish	Minnows	Sturgeon Chub	Actinopterygii	Cyprinidae	Macrhybopsis gelida	G3	S2S3		Large prairie rivers
Fish	Paddlefishes	Paddlefish	Actinopterygii	Polyodontidae	Polyodon spathula	G4	S1S2		Large prairie rivers
Fish	Perches	Sauger	Actinopterygii	Percidae	Sander canadensis	G5	S2		Large prairie rivers

Potential Species of Concern

Common Name			Scientific Name						
Class	Species	Family	Class	Species	Family	Global Rank	State Rank	ESA Rank	Habitat
Birds	Swifts	Chimney Swift	Aves	Apodidae	Chaetura pelagica	G5	S3S4B		Chimneys, caves, hollow trees
Fish	Minnows	Plains Minnow	Actinopterygii	Cyprinidae	Hybognathus placitu	G4	SU		Small and large prairie rivers
Fish	Burbot	Burbot	Actinopterygii	Gadidae	Lota lota	G5	SU		Large rivers, lakes

LEGEND

Global Rank	State Rank	Definition
G1	S1	At high risk because of **extremely limited** and/or **rapidly declining** population numbers, range and/or habitat, making it highly vulnerable to global extinction or extirpation in the state.
G2	S2	At risk because of **very limited** and/or **potentially declining** population numbers, range and/or habitat, making it vulnerable to global extinction or extirpation in the state.
G3	S3	Potentially at risk because of **limited** and/or **declining** numbers, range and/or habitat, even though it may be abundant in some areas.
G4	S4	Apparently secure, though it may be quite rare in parts of its range, and/or suspected to be declining.
G5	S5	Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.

ESA Rank	Definition
LE	**Listed endangered:** Any species in danger of extinction throughout all or a significant portion of its range (16 U.S.C. 1532(6)).
LT	**Listed threatened:** Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (16 U.S.C. 1532(20)).
PE	**Proposed endangered:** Any species for which a proposed rule to list the species as endangered has been published in the Federal Register.
PT	**Proposed threatened:** Any species for which a proposed rule to list the species as threatened has been published in the Federal Register.
C	**Candidate:** Those taxa for which sufficient information on biological status and threats exists to propose to list them as threatened or endangered . We encourage their consideration in environmental planning and partnerships ; however, none of the substantive or procedural provisions of the Act apply to candidate species.
DM	**Recovered, delisted, and being monitored** - Any previously listed species that is now recovered, has been delisted, and is being monitored.
NL	**Not listed** - No designation.
XE	**Experimental - Essential population** - An experimental population whose loss would be likely to appreciably reduce the likelihood of the survival of the species in the wild.
XN	**Experimental - Nonessential population** - An experimental population of a listed species reintroduced into a specific area that receives more flexible management under the Act.
CH	**Critical Habitat** - The specific areas (i) within the geographic area occupied by a species, at the time it is listed, on which are found those physical or biological features (I) essential to conserve the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by the species at the time it is listed upon determination that such areas are essential to conserve the species.
PS	**Partial status** - status in only a portion of the species' range. Typically indicated in a "full" species record where an infraspecific taxon or population , that has a record in the database has USESA status , but the entire species does not.

6.2.4.3.1.4 Reproductive Characteristics

Golden eagles first breed when four to five years old. The same pair often uses the same nest year after year; nests are sometimes over six feet in diameter. One to three eggs are laid in March or April, and incubated for about 45 days. The eaglets fly in June or July when about 10 weeks old. Eggs laid early April hatch in mid-May, and fledge in mid-July to early August.

6.2.4.3.2 Great Blue Heron

6.2.4.3.2.1 Habitat

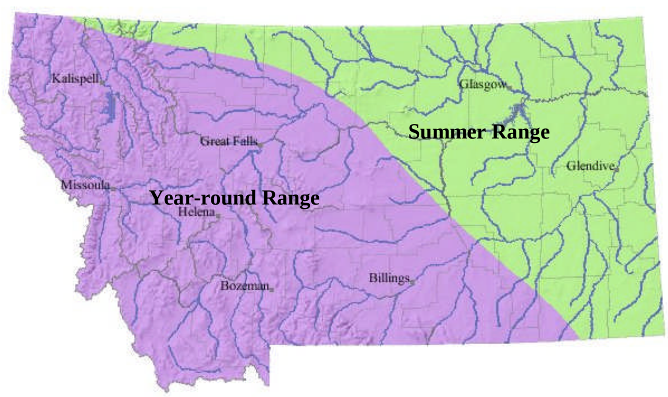
Great Blue Herons in northwestern Montana nested primarily in cottonwoods in riparian zones, and also in drier, coniferous sites. Nesting trees are the largest available. Active colonies are farther from rivers than inactive colonies. The number of nests in the colony corresponded to the distance from roads.

Great Blue Heron — *Ardea herodias*. Montana Field Guide. Retrieved on January 21, 2010, from http://FieldGuide.mt.gov/detail_ABNGA04010.aspx

6.2.4.3.2.2 Food Habits

Great Blue Herons feed mostly in slow moving or calm freshwater, eating mostly fish but also amphibians, invertebrates, reptiles, mammals, and birds.

6.2.4.3.2.3 Reproductive Characteristics



Great Blue Herons are mostly monogamous, choosing new mates each year. Nests are most commonly constructed in trees up to 30 meters or more above the ground. Where trees are not available, nests are constructed on the ground. Clutch size ranges from 2 to 6 eggs. Breeding begins in April, and young may still be in the nest in July. However, rookery activity has been seen as early as March 23.

6.2.4.3.3 Greater Sage-Grouse

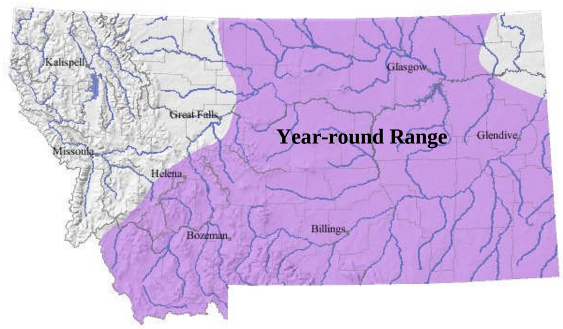
6.2.4.3.3.1 Habitat

Sagebrush is the preferred habitat of the Greater Sage Grouse. Birds use 6 to 18 inch high sagebrush covered benches in June to July (average 213 acres); move to alfalfa fields (144 acres) or greasewood bottoms (91 acres) when forbs on the benches dry out; and move back to sagebrush (average 128 acres) in late August to early September. Greater Sage-Grouse — *Centrocercus urophasianus*. Montana Field Guide. Retrieved on January 21, 2010, from http://FieldGuide.mt.gov/detail_ABNLC12010.aspx

6.2.4.3.3.2 Food Habits

Chicks eat mostly insects (60%); juveniles mostly forbs (75%) (dandelion and salsify); adults mostly big sagebrush and dandelion (79%).

6.2.4.3.3.3 Ecology



Lek activity extends from March to May. Mating sites move from year to year with nests located 0.2 to 6.5 miles from the lek. Birds populations were abundant in the last century but many are now gone. Grazing and agricultural development led to a 50% decrease in populations by the 1930s.

6.2.4.3.3.4 Reproductive Characteristics

In southwest Montana 34% of hens observed had broods, with the average brood size being 4.3 chicks. Courtship starts in early March and persists until nesting in May. Egg records are probably similar to Wyoming: April 18 to July 27.

6.2.4.3.4 Bald Eagle

6.2.4.3.4.1 Habitat

In Montana, as elsewhere, the Bald Eagle is primarily a species of riparian and lacustrine habitats (forested areas along rivers and lakes), especially during the breeding season. Important year-round habitat includes wetlands, major water bodies, spring spawning streams, ungulate winter ranges and open water areas. Wintering habitat may include upland sites. Nesting sites are generally located within larger forested areas near large lakes and rivers where nests are usually built in the tallest, oldest, large diameter trees. Nesting site selection is dependent upon maximum local food availability and minimum disturbance from human activity. Bald Eagle — *Haliaeetus leucocephalus*. Montana Field Guide. Retrieved on January 21, 2010, from http://FieldGuide.mt.gov/detail_ABNKC10010.aspx.

6.2.4.3.4.2 Food Habits

The majority of their diet is comprised of fish. Important prey for Bald Eagles are waterfowl (especially in the winter), salmonids, suckers, whitefish, carrion, and small mammals and birds.

6.2.4.3.4.3 Ecology

The number of Bald Eagles in January increased from about 260 in 1980 to about 450 in 1984. Eagles on McDonald Creek in Glacier National Park increased from a peak of less than 50 in 1939 to a peak of more than 500, and have since declined because of a drop in the number of kokanee salmon spawning on McDonald Creek. Fall/winter concentrations have been noted on the Missouri River at Canyon Ferry Dam and at Fort Peck. Bald Eagles were removed from the endangered species list in June 2007 because their populations recovered sufficiently.

6.2.4.3.4.4 Reproductive Characteristics

The Bald Eagle breeds at approximately 5 to 6 years of age. Nests are often massive structures of branches and sticks with an interior cup lined with grass, pine needles, and plant stems. Nests may be used year after year, resulting in huge constructions, sometimes up to 12 feet in height and 8 feet in diameter. Most nests are in timber stands, 1.2 hectares with a canopy closure less than 80%. The most common nest trees are ponderosa pine, Douglas fir and cottonwood. The eggs are white, non-glossy, short ovals averaging 71 x 54 mm in size. The clutch, usually consisting of two eggs, but may range from one to three, is laid in March or April. Incubation, performed by both sexes, lasts about 5 weeks. Mortality for the second young to hatch is high. First flight occurs at 10 to 12.5 weeks. The young are cared for by the adults at this time and may remain around the nest for several weeks after fledging. Adults may not reproduce every year.

Breeding dates in Montana range from March to July. The Montana Department of Fish, Wildlife and Parks coordinates nest monitoring annually to assess nesting success. In 2001, approximately 180 nests were examined. Nesting attempts at twenty-three nests were unsuccessful; 28 were either unoccupied during the breeding season, were occupied by another species, or the fate was unknown; and the remaining nests produced 256 fledglings.

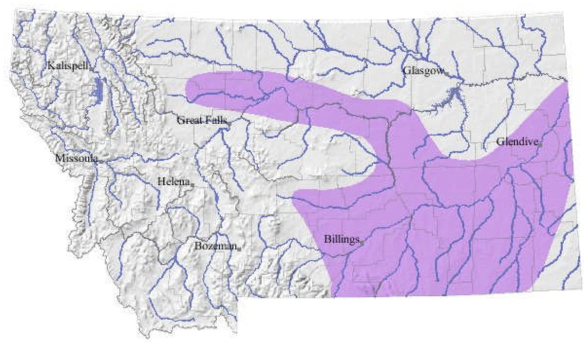
6.2.4.3.4.5 Management

General objectives of habitat management for Bald Eagles in Montana include: maintaining prey bases; maintaining forest stands currently used or suitable for nesting, roosting, and foraging; planning for future potential nesting, roosting, and foraging habitat; and minimizing disturbances from human activities in nest territories, at communal roosts, and at important feeding sites. The Montana Bald Eagle Management Plan (MBEWG 1994) directs management of this species in the state.

6.2.4.3.5 Spiny Softshell

6.2.4.3.5.1 Habitat

Habitat use by spiny softshells in Montana is probably similar to elsewhere in the range, but studies are lacking and there is little qualitative information available. They occupy larger rivers and tributaries. Both sexes have been observed basking together on partially submerged logs in backwater sites of slow-moving water, and on sandy or muddy riverbanks. Spiny Softshell — *Apalone spinifera*. Montana Field Guide. Retrieved on January 21, 2010, from http://FieldGuide.mt.gov/detail_ARAAG01030.aspx



The spiny softshell is primarily a riverine species, occupying large rivers and river impoundments, but also occurs in lakes, ponds along rivers, pools along intermittent streams, bayous, irrigation canals, and oxbows. It usually is found in areas with open sandy or mud banks, a soft bottom, and submerged brush and other debris. Spiny softshells bask on shores or on partially submerged logs. They burrow into the bottoms of permanent water bodies, either shallow or relatively deep (0.5 to 7.0 meters), where they spend winter. Eggs are laid in nests dug in open areas in sand, gravel, or soft soil near water.

6.2.4.3.5.2 Food Habits

The food habits in Montana have not been studied. Elsewhere, spiny softshells forage in the water, often in shallows with vegetation. They are considered to be generalist carnivores, and usually feed on the bottom. Major foods are crayfish, aquatic insects (of at least seven orders), and fishes, but mollusks, worms, isopods, amphibians, carrion, and vegetation also are eaten. The diet in an Iowa study was about 25% insects, 36.5% fish as carrion, 5.8% small fish as live prey, and 55% crayfish, with plant material in 61% of the stomachs sampled; this breakdown of categories appears representative for other states. Prey may be chased, ambushed, or flushed and pursued.

6.2.4.3.5.3 Ecology

Animals are active from April to October (usually May to September) in Kentucky and Colorado. Water temperatures of 12˚ C appear to determine when animals enter or emerge from hibernation in Vermont). Adults emerge earlier from hibernation, and remain active longer into the fall, than juveniles. The period of activity in Montana is poorly documented, with records from early June to late July. Egg predators include striped and spotted skunks, raccoons, red foxes, and probably coyotes; young turtles are captured and eaten by predatory fish, wading birds, and muskrats. Some individuals are caught by anglers using live or dead bait, and then killed. No information on predators is available from Montana, but some adults are incidentally captured and killed by anglers.

6.2.4.3.5.4 Reproductive Characteristics

No specific information is available for Montana, but data from other locations indicate that eggs are laid mostly in the second half of May and in June (most areas), mainly in the first half of June in southern Ontario and mid-June to early July in the far north. In Colorado evidence indicates nesting is from late May to early July, with June as the norm. In the more arid Great Plains and Rocky Mountain states, nesting activities may be stimulated by spring and early summer rains; most nesting occurs in either the morning or evening. Nests are bowl-shaped, with a narrower opening descending to a larger egg chamber; depths are usually from 7 to 18 centimeters, but may be up to 26 centimeters or more.

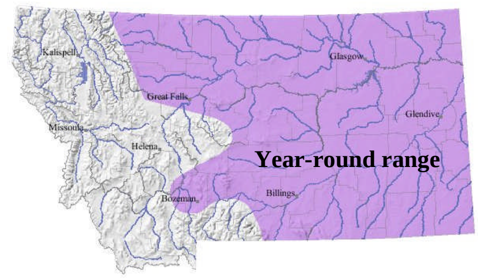
Clutch size averages 20 to 40 eggs, but may be as few as 6 or as high as 109. A single clutch is produced, with most mature females nesting each year, although some may skip a year. Hatchlings emerge in 55 to 125 days in late August to early October (mainly September).

Females are sexually mature in about 8 years in Iowa, 10 to 20 years in Ontario (later in north than in south), and 11 to 16 years in southeastern Michigan. Also in Ontario, the mean age of first nesting was estimated at 17 to 19 years; size at maturity is about 26 centimeters carapace length in Colorado. In Ontario, the mean age of nesting females was estimated at 33 to 40 years. Total reproductive failure (nest loss) is common. In Michigan, nest survivorship over 17 years ranged from 0 to 64% and averaged 23%. In Ontario, growth rate and reproductive output increased with habitat productivity. In Michigan, minimum reproductive frequency was less than annual (0.85). The longevity record for the snapping turtle is nearly 39 years (a captive animal); estimated ages are commonly 20 to 30 years in wild populations.

6.2.4.3.5.5 Management

Montana populations of the spiny softshell are poorly understood, making management of them more difficult. It is apparent that the construction of dams and large reservoirs on rivers (e.g. Fort Peck Dam and Reservoir) is detrimental to population continuity, effectively creating smaller isolated populations. Impacts of other habitat disturbances are not clear. Studies of nesting success, population structure, dispersal, and population size need to be conducted throughout the range of both Montana sub-populations (Missouri River and Yellowstone River).

6.2.4.3.6 Greater Short-horned Lizard



6.2.4.3.6.1 Habitat

Habitat use in Montana is poorly described, but appears to be similar to other regions. Reports mention individuals on ridge crests between coulees, and in sparse, short grass and sagebrush with sun-baked soil. On the southern exposures of the Pryor Mountains, Carbon County, individuals occur among limestone outcrops in canyon bottoms of sandy soil with an open canopy of limber pine-Utah juniper, and are also present on flats of relatively pebbly or stony soil with sparse grass and sagebrush cover. Greater Short-horned Lizard — *Phrynosoma hernandesi*. Montana Field Guide. Retrieved on January 21, 2010, from http://FieldGuide.mt.gov/detail_ARACF12080.aspx

6.2.4.3.6.2 Food Habits

This species is an invertivore. The diet of short-horned lizards includes especially ants and beetles, as well as other insects, spiders, snails, sowbugs, and other invertebrates. Individuals may sometimes gorge themselves on a single type of prey. The diet in Montana is virtually undescribed; stomach contents of three individuals from coulees near the Marias River in Toole County included mostly ants with a few beetles, grasshoppers, and spiders.

6.2.4.3.6.3 Ecology

Adult short-horned lizards are diurnal and active during the warmer daylight hours. Specific information for Montana is limited, but information from other areas within their range indicates they may appear as early as late March, with most surface activity in the northern parts of the range occurring from mid-April to mid-September. Extreme records in Alberta extend from April 1 to November 10, but most have disappeared by the mean date of the first fall frost. Young-of-the-year are generally not active during mid-day hours, and small lizards appear more dependent on air temperatures than on substrate temperatures, while large ones are more dependent on substrate temperature. Predators of this species are mostly unknown, but striped whipsnake (*Masticophis taeniatus*) and Burrowing Owls (*Speotyto cunicularia*) have been reported, and birds have been identified as the primary predatory group. The annual period of activity in Montana in poorly defined, and no predators have been reported.

6.2.4.3.7 Reproductive Characteristics

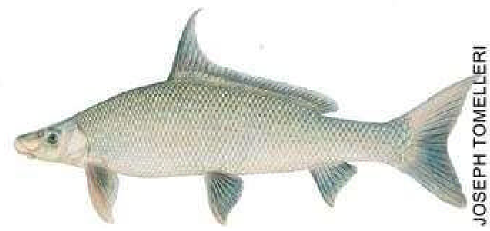
No studies of the life history and reproduction of this species have been conducted in the state. In extreme southern Montana, young about 3.0 to 3.5 centimeters snout-vent length have been observed in early August and early September.

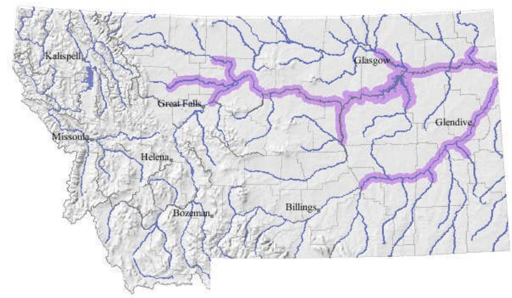
Based upon information gathered from other areas within the species' range, adult short-horned lizards mate shortly after emerging from hibernation in late March to early June, depending on location, and young are born about two or three months after eggs are fertilized. The short-horned lizard is viviparous, giving live birth to 5 to 36 young (3 to 15 in the Pacific Northwest) during July to September. The size of 8 litters from Alberta, born in late July to early August, ranged from 6 to 13 young and 5 litters in Colorado ranged from 14 to 18 young. A litter of 13 young was born in southern Wyoming in early August (2.3 to 2.4 centimeters snout-vent length at birth) and consisted of two color morphs; 4 young were stillborn. Sexual maturity is reached in at least two years.

6.2.4.3.7.1 Management

Threats to this species in Montana are speculative, due to lack of study and poor survey coverage. The short-horned lizard was considered the most abundant reptile along the Missouri River in Montana in the late 19th century, second only to the western rattlesnake, but it is no longer thought common anywhere in the state, with the possible exception of southern Carbon County. The relatively few records in recent years parallel the pattern for Colorado, but inadequate survey coverage makes conclusions regarding trends in Montana tenuous. Habitat loss due to the conversion of prairie to cropland has undoubtedly contributed to the apparent decline, but livestock grazing is probably not a serious threat to any population, judging from reports in other regions. However, clearing of sagebrush to increase grass production for livestock could have detrimental impacts on local populations of short-horned lizards. Off-road recreational vehicle traffic and increased traffic associated with road building to oil and gas developments in eastern Montana could also have negative impacts on some populations. Indiscriminant use of insecticides to control some insect species could also affect the food supply of this lizard. No management activity for this species in Montana is currently underway, nor is any proposed at this time, but the conversion of native prairie to cropland or other use will contribute to the decline of this species in the state. Within the range of the short-horned lizard in Montana where sagebrush control is planned, some sage should be left in a network of patches to insure population persistence of these lizards. Given the small home range size of the species, thinning of sagebrush or removal in small patches is probably a better management guideline than removing sagebrush entirely or in large patches.

6.2.4.3.8 Blue Sucker





6.2.4.3.8.1 Migration

In the spring blue suckers migrate upriver and congregate in fast, rocky areas to spawn. Blue suckers make long spawning movements from the lower Missouri River to upstream areas and tributary streams. Large numbers have been observed migrating up tributary streams to spawn. Dispersal downstream follows. Blue Sucker — *Cycleptus elongatus*. Montana Field Guide. Retrieved on January 21, 2010, from http://FieldGuide.mt.gov/detail_AFCJC04010.aspx

6.2.4.3.8.2 Habitat

The blue sucker is adapted for life in swift currents and prefers waters with low turbidity. The Tongue, Marias, Milk and Teton Rivers are the tributary streams most heavily used.

6.2.4.3.8.3 Food Habits

The species feeds mainly on aquatic insects in cobble areas.

6.2.4.3.8.4 Ecology

Blue suckers can live longer than 17 years. Blue suckers sampled in Montana are typically older and larger fish, with lengths of 60 to 75 centimeters and weights of 3 to 5 kilograms. Approximately 93% of sampled fish in the upper Missouri were 9 to 14 years old. The blue sucker is monogenetic and is not known to hybridize with any other species.

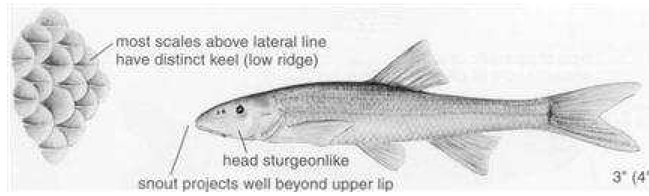
6.2.4.3.8.5 Reproductive Characteristics

Reproductive success may be a problem for this habitat-specific species. Very few young-of-the-year blue suckers have been collected while sampling with a variety of methods. Moreover, the populations are dominated by older fish, indicative of minimal recruitment. Blue sucker larvae have been collected from the Milk River, Big Muddy Creek, and in the lower Missouri and Yellowstone Rivers. Additionally, young-of-the-year blue suckers have been sampled at the Milk River confluence and in Big Muddy Creek of the lower Missouri River. Blue suckers are probably sexually mature at 2 to 3 years. They spawn in April to June at temperatures of 50˚ F.

6.2.4.3.8.6 Management

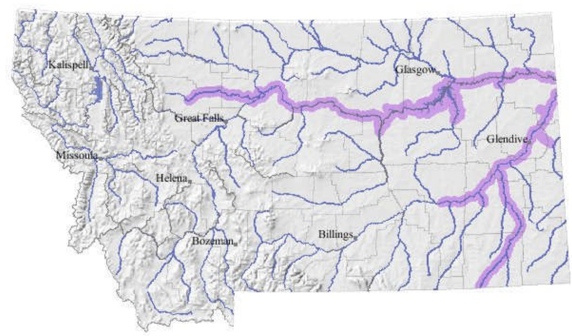
Management of the blue sucker consists mainly of routine monitoring of population status and habitat protection. The blue sucker is considered an indicator species for ecosystem health because of its habitat-specific requirements. Current monitoring information indicates the populations are in stable condition. Efforts to locate spawning and rearing areas should be continued. Habitat protection includes protecting or promoting the natural spring-time hydrograph. Establishment of more natural seasonal flow conditions are presently being discussed and initiated for three storage reservoirs in Montana.

6.2.4.3.9 Sturgeon Chub



6.2.4.3.9.1 Habitat

Sturgeon chub are found in turbid water with moderate to strong current over bottoms ranging from rocks and gravel to coarse sand. In the Powder River, sturgeon chub were taken most frequently at sites with depths less than 51 centimeters and depth velocities of less than 90 centimeters per second at 0.6 depth. Sturgeon Chub — *Macrhybopsis gelida*. Montana Field Guide. Retrieved on January 21, 2010, from http://FieldGuide.mt.gov/detail_AFCJB53020.aspx



6.2.4.3.9.2 Food Habits

A Powder River, Wyoming study showed sturgeon chub to feed mostly on small invertebrates living on the bottom substrate.

6.2.4.3.9.3 Ecology

Sturgeon chub are often found with longnose dace. Young of the year may be associated with a sand bottom. Dam building disrupts required habitat. Average lengths at ages 1 through 3 were calculated to be 48, 69 and 80 millimeters respectively. Apparently few fish reach age 4 (Stewart 1981).

6.2.4.3.9.4 Reproductive Characteristics

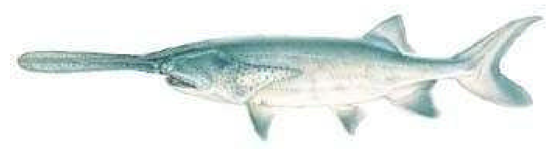
The biology of sturgeon chub is not well known. It apparently spawns from June through July. Ripe fish have been found in waters of about 18 to 25˚ C. Sexual maturity is obtained by age 2 at sizes of about 76 millimeters total length. Females produce 2000 to 3500 eggs.

6.2.4.3.9.5 Management

The management of this species should involve routine monitoring (once every 2 to 3 years) of existing populations. The program should be designed to monitor population trends, range expansion or losses and collect additional information on life history and ecology. This could be conducted while sampling for other species. Recommendations for operating reservoir and irrigation projects should be developed for improving and maintaining sturgeon chub populations and habitats in Montana.

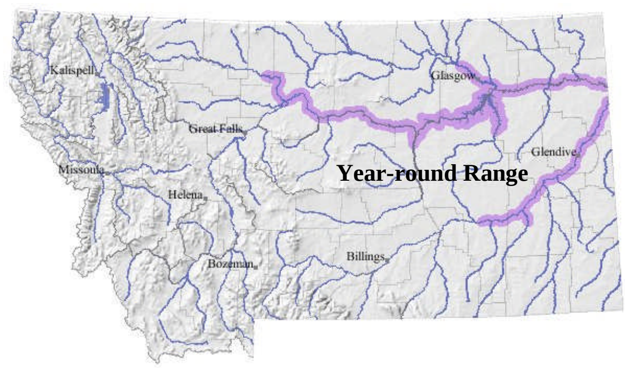
6.2.4.3.10 Paddlefish

6.2.4.3.10.1 Migration



Spawning migrations of paddlefish are tied closely with the timing of spring high water. Paddlefish — *Polyodon spathula*. Montana Field Guide. Retrieved on January 21, 2010, from http://FieldGuide.mt.gov/detail_AFCAB01010.aspxPrivacy & Security

6.2.4.3.10.2 Habitat



Habitat includes slow or quiet waters of large rivers or impoundments. They spawn on gravel bars of large rivers during spring high water. Paddlefish tolerate, or perhaps seek, turbid water.

6.2.4.3.10.3 Food Habits

Young-of-year paddlefish will "bite" at small food particles, but eventually (within a year) switch to filtering for food as they grow and need more food. Young paddlefish are pale, nearly transparent, and swim in loose groups, preferring to feed on a large zooplankton called *Leptodora kindtii*.

When feeding, adult paddlefish swim with their mouths wide open and filter the zooplankton from the water with filament-like gill rakers. In some places, adult paddlefish also filter aquatic insects and, occasionally, tiny fish. Recent research has shown conclusively that the paddle is an electrosensory structure that functions much like an antenna. It detects weak electric fields. The paddle, head and gill flaps are covered with tiny sensory pores that it uses to detect food organisms. The paddle may also function to keep the fish level in the water while it is continually moving and feeding. The paddle would then provide "lift" much like airplane wings to keep the fish from nose-diving to the bottom.

6.2.4.3.10.4 Ecology

The paddle is not developed at all on very young fish, but by the time the fish reaches 8 inches, the paddle may be half the total length of the fish. As the fish gets larger, the paddle becomes relatively shorter compared to the total length of the fish. Adult paddlefish can live without a paddle, but there is some evidence that the fish that have lost their paddles feed less efficiently and are thinner than those with their paddles intact.

Most of the large fish (40 to 90 pounds) at Intake are females which range from 15 to 50 years of age and average about 26 years. Most of the small fish (10 to 40 pounds) are males that range from 9 to 50 years old and average about 16 years. Paddlefish can occasionally live past age 50, with fish in the Yellowstone and upper Missouri River living longer than those farther south.

The Montana record is 142 1/2 pounds, caught above Fort Peck, in 1973. Fish of the Yellowstone-Sakakawea stock seldom exceed 100 pounds. Fish living in lakes and reservoirs often grow faster and larger than those living solely in rivers.

6.2.4.3.10.5 Reproductive Characteristics

When paddlefish mature, at about age 9 to 10 for males and age 16 to 17 for females, they migrate up river to spawn. Adult fish do not as a rule die after spawning, but we know from tagging studies that a given female only spawns about every 3 years, and a given male about every 2 years.

The males and females have evolved different strategies for reproducing and passing on their genes to the next generation. The larger a female is the more eggs she can produce, and the more young paddlefish she will probably produce. A male gains less by becoming large because even a small male will have millions of sperm--enough to fertilize all of the eggs from the largest female. It is preferable for males to mature at a younger age than females so they may reproduce more often, as opposed to taking the time to grow large, risking death before they spawn. Conversely, a female benefits more from the gamble she takes in delaying maturity because of the additional eggs she will produce.

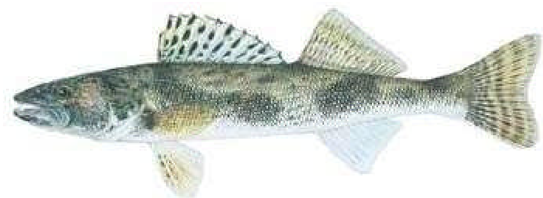
Paddlefish spawn in rivers during high water periods in late spring or early summer (May to June). In the Yellowstone River, most evidence indicates that downriver areas near Sidney and Fairview are primary spawning areas, and to a lesser extent farther upriver toward Intake. Many spawning sites are not yet well identified, however, and paddlefish undoubtedly spawn over gravel bars and areas of finer substrate in several areas of the Yellowstone River.

6.2.4.3.10.6 Management

Paddlefish stocks in Montana are adequate to support a recreational fishery. Current research and monitoring are designed to prevent over-harvest and insure a sustainable wild fishery. Managers accurately estimate the ages of the fish caught in the fisheries. Changes in the age structure of the population are being monitored to insure that young fish are added, and old fish retained, in the populations The aging of the population, along with decline in fishing success rates and higher harvest of tagged (adult) paddlefish account for the reduction of the paddlefish limit from two per person per year to one per person per year in both Montana and North Dakota, and the proposed reduction to a 1,000 fish annual harvest cap per state. The aim is to stabilize the population at 30,000 fish and avoid over-harvest of this unique, slowly-maturing species. With a fish like paddlefish that matures at an old age, has a record of reproductive problems, and is not seen often until it is large and on its upstream migration, we need to watch constantly for signs of over-harvest.

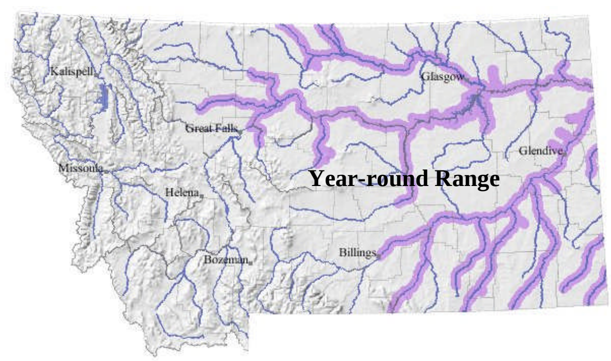
6.2.4.3.11 Sauger

6.2.4.3.11.1 Migration



Spawning is often accompanied by migration upstream and/or into tributary streams in the spring. Long migration occurs in the Yellowstone and Missouri rivers. Sauger — *Sander canadensis*. Montana Field Guide. Retrieved on January 21, 2010, from http://FieldGuide.mt.gov/detail_AFCQC05010.aspx

6.2.4.3.11.2 Habitat



Sauger inhabit the larger turbid rivers and the muddy shallows of lakes and reservoirs. They spawn in gravelly or rocky areas in shallow water and seem to prefer turbid water.

6.2.4.3.11.3 Food Habits

The young eat aquatic insects and crustaceans. Adults feed mainly on fish. The very young feed on zooplankton. Young-of-the-year in the Missouri River are largely piscivorous.

6.2.4.3.11.4 Ecology

A large, vital spawning and feeding migration has been observed to occur from the lower reaches of the middle Missouri River to an area between Fort Benton and Morony Dam. The Tongue and Powder rivers are vital spawning areas for the Yellowstone River population.

6.2.4.3.11.5 Reproductive Characteristics

Sauger spawn from mid-April to May at water temperatures of 50 degrees F., with peaks early in May in a middle Missouri River study. They are sexually mature at 3 to 4 years. Eggs are cast over the bottom and incubate in 12 to 18 days at 50 degrees F.

6.2.5 Lands and Vegetation

6.2.5.1 Introduction

This section describes the soils and vegetation in the vicinity of the Cartersville Dam site that may potentially be affected by proposed improvements to Cartersville Dam.

6.2.5.2 Method

To inventory lands and vegetation downstream of the Cartersville Dam, GIS layers were used. These layers were developed using state and federal land use databases. This inventory was done by superimposing alternative features over land use data sets and identifying the types of lands that coincide with the project area downstream of the Cartersville Dam. These features covered soil series, topography, and existing 2005 aerial photos. These data sets were provided by the Montana State Library's National Resource Information System. Additional soil series data was provided by the National Resources Conservation Service. Vegetation and ecosystem data was provided by Montana Natural Heritage Program.

6.2.5.3 Existing Conditions

6.2.5.3.1 Ecoregion

The study area (Figure 6-9) is located directly downstream of the Cartersville Dam near Forsyth, Montana in Rosebud County. This is location is within the Northwestern Great Plains Level III ecoregion. The study area is classified by the Natural Heritage as Aquatic Ecological System Type A001 and A002, a Large River Valley. Substrate characteristics of this community are typically cobbled in the riffles, sand and gravel dominated runs and pools, with gravel and/or finer-textured side channels. The surrounding landscape is a plains cottonwood/ western snowberry woodland with evidence of existing wetlands.

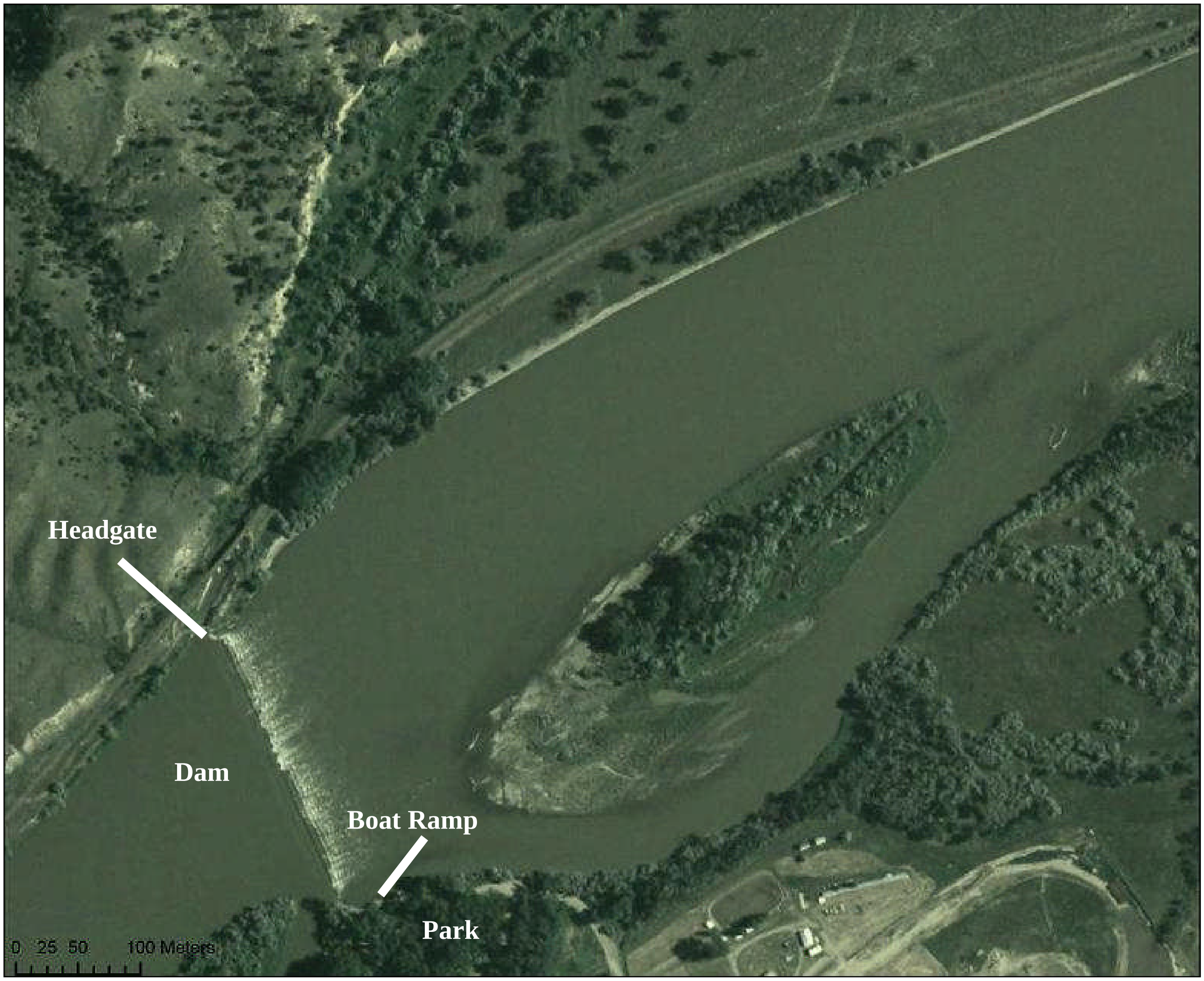


Figure 6-9 Cartersville Dam Study Area

6.2.5.3.2 Soil Series

The soils along the southern bank of the Yellowstone River have been mapped by the NRCS as Havre fine-loamy soil with mixed parent material (Figure 6-10 and Table 6-3). This is a superactive soil indicating that the area may be regularly flooded.

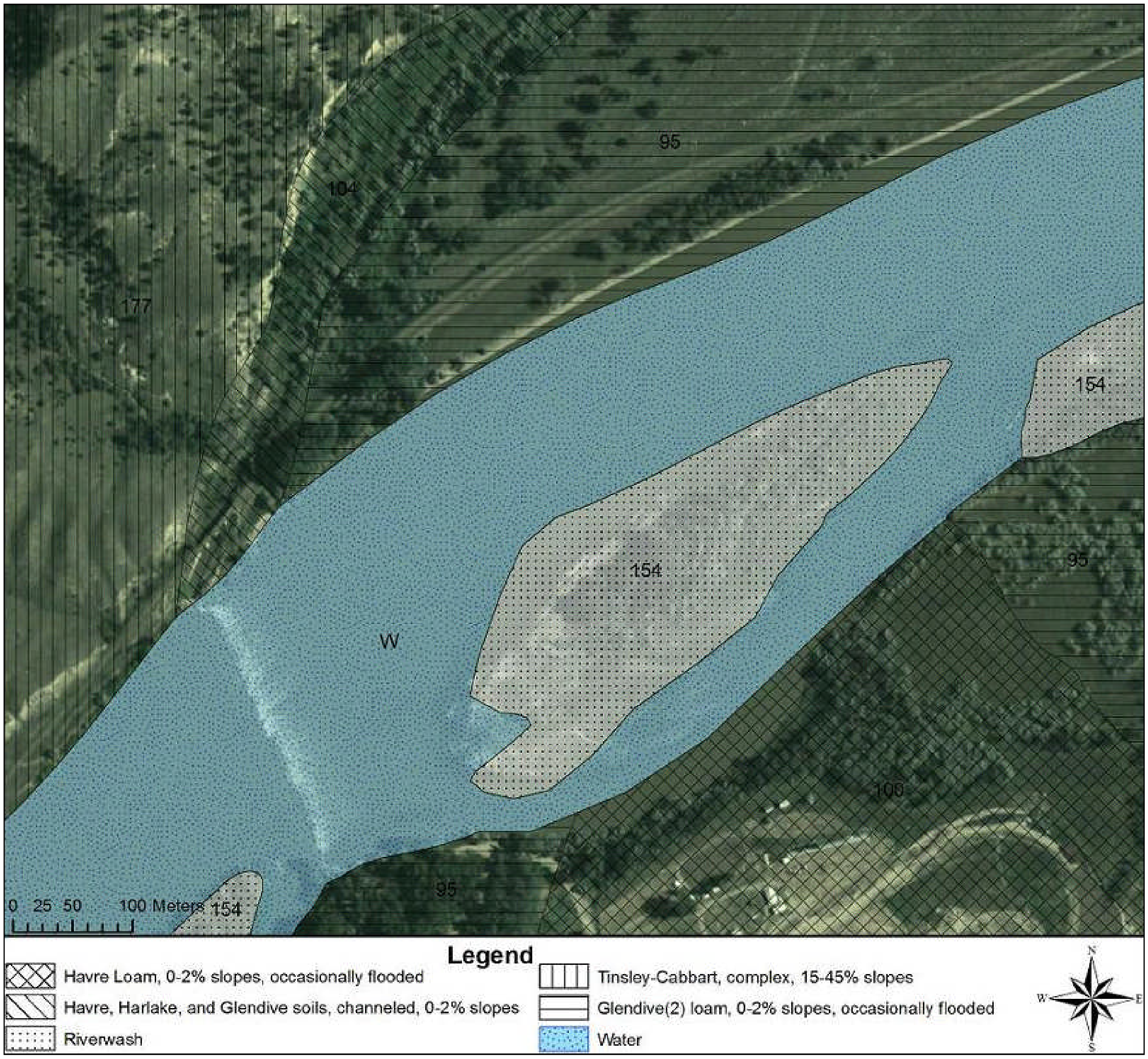


Figure 6-10 Extent of NRCS Mapped Soil Series

Table 6-3
Soil Characteristics and Descriptions

Soil Name	Family of higher taxonomic classification
Cabbart	Loamy,mixed (calcareous), frigid Ustic Torriorthents
Glendive	Coarse-loamy, mixed, superactive, calcareous, frigid Aridic Ustifluvents
Glendive(2)	Coarse-loamy, mixed (calcareous), frigid Ustic Torrifluvents
Harlake	Fine, smectitic, calcareous, frigid Aridic Ustifluvents
Harlem	Fine, montmorillonitic (calcareous), frigid Ustic Torrifluvents
Havre	Fine-loamy, mixed, superactive, calcareous, frigid Aridic Ustifluvents
Tinsley	Sandy-skeletal, mixed, frigid Ustorhents

Glendive loam soil series were mapped along the northern banks of the Yellowstone downstream of the dam and can also be found along sections of the southern bank. These soils are commonly found along floodplains and stream terraces. Like the Havre loam that dominates the southern bank, Glendive loams are superactive aridic ustifluvents, suggesting periodic overbank flooding and saturation. Glendive loams are usually well drained and are formed in stratified calcareous alluvium.

6.2.5.3.3 Wetlands

Wetland mapping data was unavailable from the MFWP NWI program, but these soils were identified on the Montana hydric soils list. Because the soil is classified as a frigid aridic ustifluvent and is identified on the Montana hydric soils list, the land on the southern bank is likely a wetland.

6.2.6 Aquatic Assemblages

6.2.6.1 Introduction

This section identifies the fish, macroinvertebrate, and mussel assemblages that exist in the project area that may be affected by the proposed alternatives.

6.2.6.2 Methods

We reviewed literature that describes the composition of the aquatic communities in the project area. Information on fish assemblages came from White and Bramblett (1993), invertebrates from Newell (1977), and mussels from the Montana Natural Heritage Program's website and from Dan Gustafson's website. We considered the relationships between fish species, movements, and habitats that may be affected by the proposed alternatives.

6.2.6.3 Existing Conditions

6.2.6.3.1 Fish Assemblages

The Yellowstone River supports a moderately diverse assemblage of fishes comprised of about 56 species representing 16 to 19 families (White and Bramblett 1993; Montana Fisheries Information System 2009). The distribution of fish species varies from headwaters to mouth, with increasing species richness proceeding downstream. The Yellowstone River has been characterized as having three fish zones. The salmonid or coldwater zone, beginning in the headwaters and continuing 221 miles downstream to the Boulder River near Big Timber, Montana supports 16 species, with mountain whitefish, rainbow trout, brown trout, Yellowstone cutthroat trout, longnose sucker, white sucker, and mottled sculpin being abundant (White and Bramblett 1993). The transition zone, located downstream of the salmonid zone, extends downstream about 160 miles to the mouth of the Bighorn River. The transition zone is now considered to be much shorter, from the confluence with the Clarks Fork to Huntley (Frazer, Verbal Communication 2010). Fish species diversity increases in the transition zone, with about 30 species present. Common species are flathead chub, longnose dace, emerald shiner, river carpsucker, shorthead redhorse, channel catfish, burbot, smallmouth bass, and sauger (White and Bramblett 1993, Mike Duncan, Montana Cooperative Fishery Research Unit, personal communication). A large change in the fish assemblage occurs in the warmwater zone, where about 49 fish species occur. Common species in this zone include shovelnose sturgeon, longnose dace, emerald shiner, flathead chub, western silvery minnow, river carpsucker, shorthead redhorse, blue sucker, smallmouth buffalo, bigmouth buffalo, channel catfish, stonecat, burbot, sauger, and freshwater drum.

The location of Cartersville Dam in the species-rich warmwater fish zone means that this structure potentially affects the connectivity of a large number of fish species. Fish assemblages in large rivers such as the Yellowstone contain many species of "big river" fishes that are noted for their long-range migrations (Schmutz and Jungwirth 1999; Pringel et al. 2000). It is very likely that the Cartersville Dam blocks upstream movement of shovelnose sturgeon as well as most if not all fish species in this reach. Matt Jaeger of Montana Fish, Wildlife and Parks observed movements of shovelnose sturgeon in this reach using radio telemetry (Jaeger et al. 2009). Twelve of 36 (33%) of radio-tagged shovelnose sturgeon had their most-upstream locations directly below the Cartersville Dam, and were apparently blocked from passing upstream of the structure (Appendix A). Shovelnose sturgeon are probably limited from the Yellowstone River above Cartersville Reservoir (Helfrich 1999; Jaeger et al. 2009; Frazer, Verbal Communication 2010), however their former distribution probably extended upstream in the Yellowstone River at least to the mouth of the Bighorn River.

The blue sucker is a highly migratory fish species and the Yellowstone River populations are likely fragmented by diversion dams, including Cartersville (Gardner 1998; Jaeger et al. 2009). Burbot and channel catfish are important fish species for recreational fishing. Jaeger et al. (2009), suggest that Cartersville and the other four upstream diversion dams may be size-selective barriers to channel catfish. Very little is known about burbot movements in the Yellowstone River, but diversion dams are a concern for this species (Jaeger et al. 2009). Sauger are important game fish in the lower Yellowstone River. Although adult radio-tagged sauger were documented passing all diversion dams on the Yellowstone River (except Huntley Diversion), diversion dams are probably a barrier to juvenile sauger (Jaeger et al. 2005). Emerald shiner have been observed aggregating and presumably blocked from upstream movement below the Cartersville Dam (Robert G. Bramblett, personal observation).

Currently, Cartersville Dam appears to block upstream movement of shovelnose sturgeon (Jaeger et al. 2009) as well as juvenile sauger (Jaeger et al. 2005). Although Helfrich et al. (1999) reported that Cartersville Dam did not create any disjunct fish populations; it is likely that upstream passage is impeded for some proportion of the 40-50 fish species present in the project area. For example, total numbers of shorthead redhorse, goldeye, *Hybognathus* sp. (likely western silvery minnow), emerald shiner, and river carpsucker were higher below Cartersville Dam than above it. The total number of all fish species fish captured was also higher below Cartersville.

No experiments directly testing fish passage have been performed at Cartersville Dam; however fish passage was studied at Intake and Huntley diversion dams (Helfrich et al. 1999). Individual fish were captured, marked, and released above and below Intake and Huntley diversion dams. Of 4,430 representing 37 species marked below Huntley Dam, 13 fish representing 7 species were recaptured upstream of the dam. At Intake dam, 4,080 fishes were marked and 17 fish of 4 species were recaptured above the dam (Helfrich et al. 1999). Species documented as passing Huntley dam were white sucker, common carp, goldeye, brown trout, shorthead redhorse, longnose sucker, and flathead chub. Species documented as passing Intake dam were goldeye, walleye, sauger, and smallmouth buffalo. Recapture of fish passing dams was unrelated to abundance of marked fish or size of marked fish. The authors speculate that passage was related to swimming ability, because those species in which passage was thought to occur were strong swimmers, although no swimming performance data are available for most warmwater nongame species. The experiments were conducted during summer, and the fish that passed the dams did so in July and September. River discharges were high during the experimental periods, and the presence of natural bypass channels around both dams during high flows may have allowed fish to pass upstream of the dams without actually negotiating the dams. Although few fish were recaptured above the dams, some fish may have passed and continued upstream without being detected during recapture efforts.

6.2.6.3.2 Macroinvertebrates

Little information exists for macroinvertebrate communities on the Yellowstone River (White and Bramblett 1993). Newell (1977) sampled macroinvertebrate communities at 20 sites arrayed longitudinally from just below Yellowstone National Park to just above the confluence of the Missouri River in North Dakota in late summer and fall of 1975. Species richness and diversity declined from upstream to downstream. Mayflies (Order Ephemeroptera) totaled 37 species and ranged from 19 species per site in the salmonid zone to 10 species at the two lowermost sites. Thirty seven stonefly (Order Plecoptera) species were collected; species richness was 21 species at the uppermost site and declined rapidly downstream in the transition zone. Caddisflies (Order Trichoptera) had a similar species richness pattern, totaling 36 species and declining from upstream to downstream. The river near Cartersville Dam probably supports about 15-20 mayfly species, 10-15 caddisfly species, and 1-5 stonefly species. True flies (Order Diptera) were found throughout the river, as were beetles (Order Coleoptera), whereas dragonflies (Order Odonata), true bugs (Order Hemiptera) were found only in the transition and warm water zones. Noninsect macroinvertebrates collected included turbellarians, oligochaetes, mollusks, isopods, amphipods, and acarians (Newell 1977).

Aquatic insect dispersal is probably not currently affected by Cartersville Dam. Aquatic insects drift downstream with the current; Cartersville Dam does not prevent drift. Following emergence as adults, aquatic insects are able to fly upstream to lay eggs, thereby preventing depletion of upstream habitats.

6.2.6.3.3 Mussels

There is one mussel species (Family Unionidae) in the project area, the fatmucket (*Lampsilis siliquoidea*). This species is native in the larger prairie rivers of Montana and found in areas with gravel, sand and silt substrates. It is fairly tolerant of silt and warm to cool water temperatures. It is considered to be an S5 species by the Montana Natural Heritage program, meaning it is common, widespread, and abundant (although it may be rare in parts of its range), but not vulnerable in most of its range. Larval freshwater mussels (glochidia) are parasites of fish, and attach themselves to the gills or fins of the fish for a period of time. Eventually the glochidia break free and settles to the bottom of the river to begin an independent life. This parasitic phase allows mussels to move and disperse with fish through watersheds, including in an upstream direction. Host fish species for the fatmucket in Montana are the freshwater drum, channel catfish, stonecat, sturgeons, common carp, black bullhead, sunfishes and bass, and yellow perch. Fingernail clams (Family Sphaeriidae) are present in Montana, but there is little information on their identity, distribution, or ecology.

6.2.7 Recreation

6.2.7.1 Introduction

This section describes the existing conditions regarding recreational activities including fishing in the project area.

6.2.7.2 Methods

We consulted Montana Fish, Wildlife and Parks MFISH webpage and existing literature for information on fishing in the project area. In addition we have obtained information from members of the community.

6.2.7.3 Existing Conditions

The Yellowstone River is one of North America's most highly regarded fishing rivers. The salmonid zone attracts the highest fishing activity and Montana Fish Wildlife, and Parks considers the upper river as an outstanding Fisheries Resource Value (MFISH). In the warmwater zone, very few trout are present and fishing pressure decreases (Frazer, Verbal Communication 2010). However, FWP considers the Fisheries Resource Value to be high-value in the project area.

Game fish in the project area include channel catfish, northern pike, burbot, smallmouth bass, sauger, and walleye (White and Bramblett 1993). The area adjacent to and below the Cartersville Dam is a popular fishing location and a boat ramp is located at the state park just downstream of the dam on the right bank (Figure 6-9). Fish that are unable to pass upstream of the diversion dam likely aggregate and are available for angling.

In addition, the community uses the state park on the south bank of the Yellowstone River at the dam extensively for swimming, picnicking, boating, and other social events.

6.3 Cultural Resources

6.3.1 Introduction

Historic property includes any prehistoric or historic district, site, building, structure or object included in or eligible for inclusion on the Natural Register of Historic Places (National Register). This can also include sites, locations, or areas valued by Native Americans (USACE, 2000).

A cultural resources study is defined as a scientific investigation conducted for the following purposes (USACE, 2000):

- Discovering cultural resources;
- Confirming their location, extent, and character;
- Evaluating their significance;
- Determining their research potential;
- Determining potential project effects; and
- Developing alternate preservation and/or mitigation plans.

Feasibility phase cultural resources investigations shall usually begin with a literature and records review (USACE, 2000).

6.3.2 Method

Consultation with SHPO in Helena, Montana was used to determine whether any cultural resources exist in the project area.

6.3.3 Existing Conditions

The Montana Historical Society indicates there have been a few previously recorded sites with the designated search locale. Site 24RB1000 is the Cartersville Irrigation system which is eligible for listing on the National Register of Historic Places. In addition to the site there have been inventories done in the area.

6.4 Aesthetic Resources

6.4.1 Introduction

Aesthetic resources include those natural resources, landform, vegetation and man-made structures in the environment which generate one or more sensory reactions and evaluations by the observer, particularly in regard to pleasurable response (USACE, 2000).

6.4.2 Method

Members of the community have expressed their feelings regarding the aesthetic value of the project.

6.4.3 Existing Conditions

Members of the community indicate the diversion dam and adjacent park are an important aesthetic resource that should be protected.

6.5 Water Quality

6.5.1 Introduction

The following section contains a summary of surface water quality conditions at the site. This includes a summary of available water quality data collected by the US Geological Survey, as well as a description of water quality impairment listings developed by the State of Montana.

6.5.2 Method

The summary provided is based on publications produced by the Montana Department of Agriculture (http://agr.mt.gov), Montana Department of Environmental quality (http://deq.mt.gov), and the United States Geological Survey (Zelt, et al, 1998; Miller et al, 2004).

6.5.3 Existing Conditions

From the mouth of the Big Horn River to the mouth of the Powder River, the Yellowstone River has been classified as by the state of Montana a Class B-3 water body (http://cwaic.mt.gov). Class B-3 standards are as follows: Suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply (http://deq.mt.gov).

From the Big Horn River to Cartersville Dam, the river has been listed as partially supporting of the warm water fishery, and the probable cause of this impairment is listed as a fish passage barrier. Between Cartersville Dam and the Powder River, the Yellowstone has been listed as partially supporting of aquatic life and the warm water fishery. The probable causes for this impairment include riparian alterations, nitrate/nitrite, pH, sediment, copper, lead, and zinc. To date, Total Maximum Daily Loads (TMDLs) have not been developed for listed waterbody.

6.5.3.1 Suspended Sediment

Zelt and others (1998) broadly summarized water quality conditions of the Yellowstone River basin using suspended sediment and dissolved solids concentrations data. They noted that land disturbances caused by human activities contribute to suspended sediment and dissolved solids in surface waters. In addition, suspended sediment concentrations relate to the types of rock units exposed on the land surface. Suspended sediment concentrations tend to be higher in stream flow through less resistant sedimentary rocks that are Mesozoic in age or younger (Zelt, et al, 1998); at Cartersville Dam, sediments in both the valley bottom and bluff line are all within this category.

Suspended sediment concentrations and suspended sediment discharge values are available for the USGS gaging station at Forsyth (Station #06295000) from 1978 to 1981. These data show that during that time, suspended sediment concentrations reached 4,000 mg/l during a 97,000 cfs flood event in May of 1978 (Figure 6-11). This flood event was also characterized by a suspended sediment discharge of 761,000 tons per day (Figure 6-12). More typically, however, spring runoff events in the 1978-1981 time frame are characterized by suspended sediment concentrations of less than 1,000 mg/l, and suspended sediment discharges of less than 150,000 tons per day (Figure 6-11 and Figure 6-12). Data derived from 42 samples collected at Forsyth between 1999 and 2001 show median suspended sediment concentration values of approximately 40 mg/l (Figure 6-13; Miller, et al, 2004).

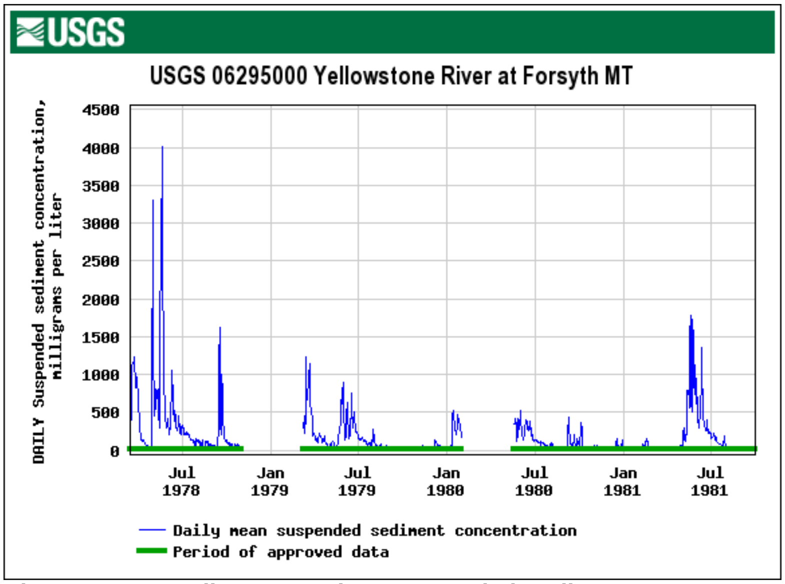


Figure 6-11 Yellowstone River Suspended Sediment Concentration Values Measured at Forsyth, 1978-1981

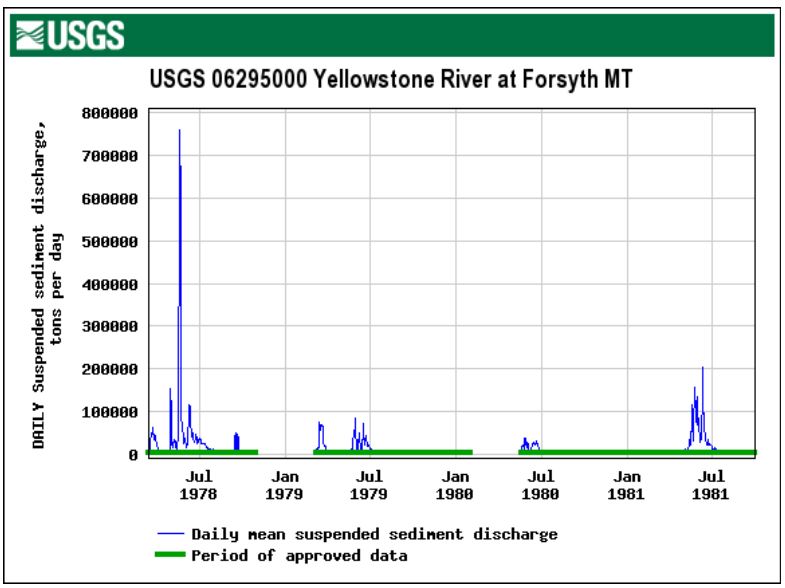


Figure 6-12 Yellowstone River Suspended Sediment Discharge Values Measured at Forsyth, 1978-1981

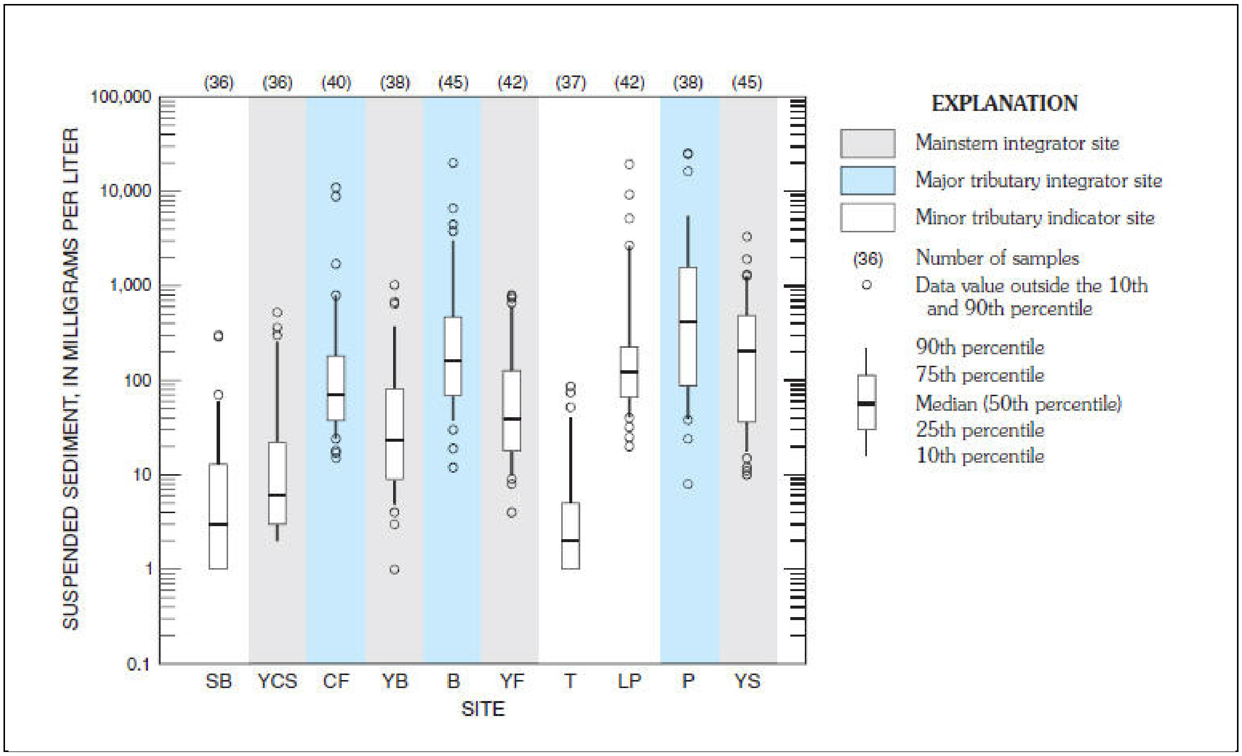


Figure 6-13 Statistical Summary of Suspended Sediment Concentrations for Yellowstone River Basin Sites, 1999-2001; YF is Yellowstone River at Forsyth (Miller, et al, 2004)

6.5.3.2 Dissolved Solids

The concentrations of dissolved solids in the Yellowstone River basin tend to be higher in streams that flow through the basins and plains areas (Zelt, et al, 1998). Dissolved solids tend to be low where crystalline rocks predominate, and higher where younger sedimentary rocks are present. Dissolved solids concentrations tend to be higher at low river discharges. The 75th percentile values of dissolved solids calculated from gage records at Billings and Sydney are approximately 250 mg/l and 400 mg/l, respectively (Zelt, et al, 1998). Data collected at Forsyth between 1999 and 2001 show that based on 42 samples, the median dissolved solids concentration values is approximately 400 mg/l (Figure 6-14; Miller, et al, 2004).

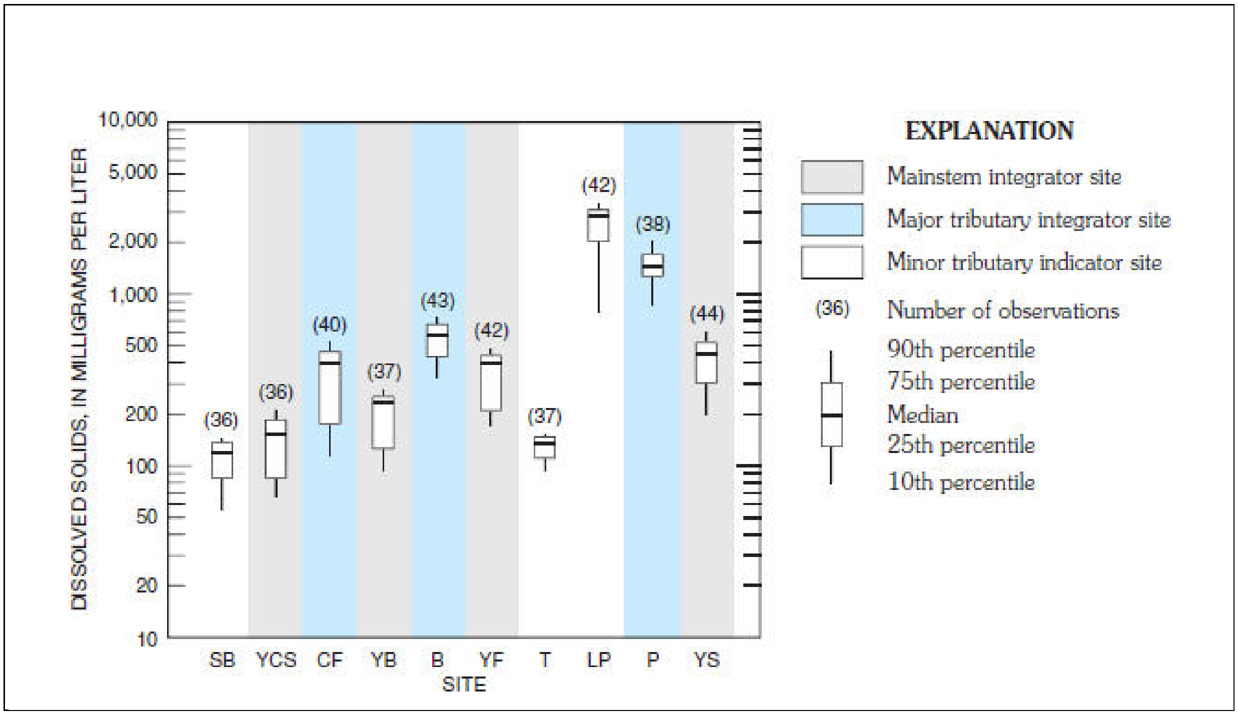


Figure 6-14 Statistical Summary of Dissolved Solids Concentrations for Yellowstone River Basin Sites, 1999-2001; YF is Yellowstone River at Forsyth (Miller, et al, 2004)

6.5.3.3 Pesticides

The USGS collected monthly water samples between January 1999 and September 2001 from the Yellowstone River near Forsyth for pesticide analysis (Miller, et al, 2004). The Montana Department of agriculture has summarized USGS sampling that extends from 1999 to 2004 (http://agr.mt.gov). The most commonly detected pesticides were atrizine, triallate, metolachlor, prometon, and cyanazine (Figure 6-15). These pesticides, with the exception of prometon, tend to be associated with agricultural uses such as with corn, sugar beets, and small grain crops. Prometon, in contrast, tends to be used in more urban areas. All of the pesticide concentrations were below any existing human health standards or aquatic life standards. Herbicides typically used in noxious weed control, such as 2,4-D, picloram, and imazapyr, were not analyzed in this effort.

6.5.3.4 Nitrates

A suite of nitrate analyses from the Yellowstone River near Forsyth were developed by the USGS, using 74 samples collected from the river between 1999 and 2004. Nitrate was detected in 72 of the 74 samples at concentrations ranging from 0.03 to 0.65 mg/l (Figure 6-15). The median concentration measured was 0.2mg/l (http://agr.mt.gov). Seasonal variations in nitrate levels were observed, with higher concentrations occurring between October and March, and lower concentrations between April and September.

Summary of Pesticide*/Nitrate Detections in the Yellowstone River near Forsyth from 1999 through September 2004 Collected by the U.S. Geological Survey							
Pesticide Compound	Number of Samples Collected	Number of Samples with Pesticide Detected	Percent of Samples with Pesticide Detected	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Drinking Water Standard (µg/L)	Aquatic Life Standard (µg/L)
Atrazine	65	51	78.5	E 0.003	0.328	3	1.80
Benfluralin	65	1	1.5	--	E 0.003	--	--
Carbaryl	65	1	1.5	--	0.005	700	0.20
Carbofuran	65	1	1.5	--	E 0.034	40	1.80
Chlorpyrifos	65	1	1.5	--	E 0.002	20	0.041
Cyanazine	65	10	15.4	E 0.003	0.018	1	2.0
EPTC	65	7	10.8	E 0.001	0.16	--	--
Malathion	65	1	1.5	--	E 0.004	100	0.10
Metolachlor	65	29	44.6	E 0.002	0.034	100	7.80
Prometon	65	19	29.2	M	E 0.01	100	--
Propargite	65	1	1.5	--	0.41	--	--
Simazine	65	1	1.5	--	E 0.003	4	10
Tebuthiuron	65	2	3.1	M	E 0.01	500	1.60
Triallate	65	33	50.8	E 0.001	0.012	--	0.24
Trifluralin	65	1	1.5	--	E 0.002	5	0.20
Nutrient Compound	Number of Samples Collected	Number of Samples with Nitrate Detected	Percent of Samples with Nitrate Detected	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)	Drinking Water Standard (mg/L)	Aquatic Life Standard (mg/L)
Nitrate + Nitrite	74	72	97.3	0.03 E	0.65	10	--
E = Estimated value M = Presence of chemical verified but not quantified * This table only contains a summary of pesticides detected; many other pesticides were analyzed for and not detected							

Figure 6-15 Summary of Pesticide and Nitrate Detections in Yellowstone River Near Forsyth, 1999-2004 (http://agr.mt.gov)

6.6 Air Quality

6.6.1 Introduction

The section addresses ambient air quality at the project site in Forsyth, Montana.

6.6.2 Method

The Montana Department of Environmental Quality (DEQ) was contacted to determine if any ambient air quality data exists in the Forsyth area.

6.6.3 Existing Conditions

The DEQ indicates the closest air quality station to Forsyth is located in Colstrip, Montana, approximately 26 miles to the south.